

What is claimed is:

- 1 1. A method for analyzing a flip chip die, the method comprising:
2 providing a flip chip die having a back side opposite circuitry at a circuit side
3 and having a liquid crystal layer formed over a thinned region in the back side;
4 generating heat in the die circuitry; and
5 detecting a defect in the die by detecting a portion of the liquid crystal changing
6 phase.
- 1 2. The method of claim 1, wherein providing a flip chip die having a liquid crystal
2 layer formed over a thinned region in the back side comprises:
3 removing at least a portion of substrate from the back side and forming the
4 thinned region; and
5 forming a liquid crystal layer over at least a portion of the thinned region.
- 1 3. The method of claim 2, wherein removing at least a portion of substrate from the
2 back side and forming the thinned region includes removing an amount of substrate
3 sufficient to allow heat transfer for the liquid crystal analysis while not allowing the die
4 to be damaged during removal from a package.
- 1 4. The method of claim 2, wherein removing at least a portion of substrate from the
2 back side and forming the thinned region includes forming a thinned region having
3 sufficient roughness to facilitate the formation of the liquid crystal layer.

1 5. The method of claim 2, wherein forming the liquid crystal layer includes at least
2 one of: mixing liquid crystal material with a solvent sufficient to allow the liquid
3 crystal to flow, wherein the solvent evaporates and leaves the liquid crystal layer
4 behind; and depositing liquid crystal emulsion on the thinned region and directing an air
5 blast to the emulsion.

1 6. The method of claim 1, wherein generating heat in the die circuitry includes
2 heating the die using an external heat source.

1 7. The method of claim 1, wherein generating heat in the die circuitry includes
2 coupling a power source to the die and electrically operating the die.

1 8. The method of claim 7, further comprising varying the output of the power
2 source to change the heating rate of the circuitry within the die.

1 9. The method of claim 7, wherein electrically operating the die includes operating
2 the die in a continuous loop that includes operational conditions that induce a circuit
3 failure.

1 10. The method of claim 1, wherein detecting a defect in the die includes using a
2 laser scanning microscope having a polarized light source and an analyzer.

1 11. The method of claim 1, wherein the testing arrangement includes a microscope,
2 further comprising:
3 obtaining a reference image of circuitry;
4 using the microscope to obtain an image of the defect-related liquid crystal
5 phase change in the die; and
6 superimposing the defect-related image over the reference image and providing
7 a visual representation of the portion of circuitry having a defect.

1 12. The method of claim 11, wherein the reference image is of circuitry in a non-
2 defective reference die having structure about identical to the die.

1 13. The method of claim 11, wherein the reference image is of circuitry in the die.

1 14. The method of claim 11, wherein using the microscope to obtain an image of the
2 defect-related liquid crystal phase change in the die includes at least one of:
3 photographing the phase change and marking the phase change with a graphic marker.

Am. A' 1 15. The method of claim 11, further comprising using the superimposed defect
2 image over the reference image to distinguish a liquid crystal phase change due to
3 intrinsic heat sources from a liquid crystal phase change due to a defect.

1 16. The method of claim 7, wherein electrically operating the die comprises
2 electrically operating a first circuit region and causing the first circuit region and a

3 second circuit region having a defect to effect a separately viewable phase change in
4 corresponding areas of the liquid crystal layer, the first and second circuit regions being
5 selected to cause the corresponding phase changes to cease to be separately viewable by
6 conventional real-time analysis.

Sub 92 17. The method of claim 16, wherein detecting a defect in the die as a portion of the
2 liquid crystal changing phase comprises detecting the liquid crystal phase change in the
3 area corresponding to the second circuit region before the corresponding areas cease to
4 be separately viewable.

1 18. The method of claim 1, further comprising cooling the die.

1 19. The method of claim 18, wherein cooling the die includes terminating the heat
2 generation in the die, further comprising re-generating heat in the die circuitry and re-
3 detecting the defect in the die after the die has cooled.

1 20. The method of claim 18, wherein cooling the die includes directing a cooling
2 agent at the die, the cooling agent comprising at least one of: compressed air and
3 compressed nitrogen.

1 21. A system for analyzing a flip chip die having a back side opposite circuitry at a
2 circuit side and a liquid crystal layer, the system comprising:

3 means for providing a flip chip die having the liquid crystal layer formed over a
4 thinned region in the back side;
5 means for generating heat in the die circuitry; and
6 means for testing the die, the testing means adapted to detect a defect as a
7 portion of liquid crystal changing phase.

1 22. A system for analyzing a flip chip die, the flip chip die having a back side
2 opposite circuitry at a circuit side and a liquid crystal layer, the system comprising:
3 an arrangement adapted to provide a flip chip die having the liquid crystal layer
4 formed over a thinned region in the back side;
5 an heat generation arrangement adapted to generate heat in the die circuitry; and
6 a testing arrangement adapted to detect a defect in the die as a portion of the
7 liquid crystal changing phase.

1 23. The system of claim 22, wherein the arrangement adapted to provide a flip chip
2 die having a liquid crystal layer formed over a thinned region in the back side
3 comprises:
4 a substrate removal device adapted to remove substrate from the back side of the
5 flip chip die and form a thinned region; and
6 a deposition arrangement adapted to form a liquid crystal layer on the thinned
7 region.

1 24. The system of claim 23, wherein the substrate removal device is further adapted
2 to form a thinned region having sufficient surface qualities to adhere to the liquid
3 crystal layer.

1 25. The system of claim 22, wherein the testing arrangement includes a microscope
2 having a polarized light source and an analyzer.

1 26. The system of claim 25, wherein the microscope includes a laser scanning
2 microscope.

1 27. The system of claim 26, wherein the laser scanning microscope is adapted to use
2 emission microscopy to obtain an image of the die and to use an RGB function to
3 superimpose the test image onto a reference image.

1 28. The system of claim 27, wherein the laser scanning microscope is adapted to
2 produce a laser beam having a wavelength of about 1064 nanometers.

1 29. The system of claim 25, wherein the microscope includes a stage adapted to
2 hold the die.

1 30. The system of claim 29, wherein the stage is adapted to move and to keep a
2 selected portion of the die within the field of view of the microscope.

1 31. The system of claim 25, wherein the testing arrangement is adapted to record an
2 image of the die as a function of time, the image being indicative of the liquid crystal
3 changing phase.

1 32. The system of claim 31, wherein the testing arrangement includes a storage
2 arrangement adapted to store image data.

1 33. The system of claim 32, wherein the storage arrangement is adapted to play back
2 image data in slow motion.

1 34. The system of claim 31, wherein the testing arrangement includes a camera.

1 35. The system of claim 22, wherein the heat generation arrangement includes a
2 power supply adapted to electrically operate the die.

1 36. The system of claim 35, wherein the power supply is adapted to respond to
2 variations in the clock frequency supplied to the chip.